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# THE UNITED STATES OF AMERICA

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United States Patent and Trademark Office

February 24, 2005

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APPLICATION THAT MET THE REQUIREMENTS TO BE GRANTED A  
FILING DATE UNDER 35 USC 111.

APPLICATION NUMBER: 60/590,938

FILING DATE: July 26, 2004

By Authority of the  
COMMISSIONER OF PATENTS AND TRADEMARKS



M. K. HAWKINS

Certifying Officer

## IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:

David ARLINSKY

Serial No. Not Yet Assigned

Filed: July 26, 2004

For: **IMPROVEMENTS IN DIGITAL SPIRIT LEVELS**  
(Provisional Application)TRANSMITTAL LETTERCommissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

Sir:

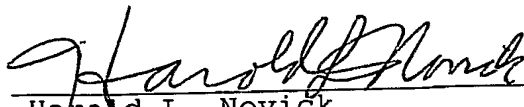
Submitted herewith for filing in the U.S. Patent and Trademark Office is the following **PROVISIONAL APPLICATION**:

- (1) Transmittal Letter
- (2) Cover Sheet for Filing Provisional Application
- (3) 7 Pages Application Consisting of:
  - 3 Pages of Textual Specification
  - 0 Pages of 0 claims
  - 0 Page of the Abstract
  - 4 Pages of Drawings.
- (4) Check No. 24413 in the Amount of \$ 80.00 for filing fee as a small entity; and
- (5) Postcard for early notification of serial number.

The Commissioner is hereby authorized to charge any deficiency or credit any excess to Deposit Account No. 14-0112.

Respectfully submitted,  
**NATH & ASSOCIATES PLLC**

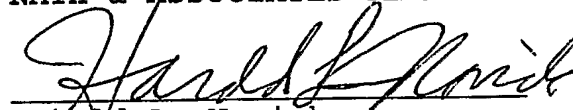
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- X \*Reduced by one-half, as applicant(s) is/are a "small entity". Applicant is eligible for Claiming Small Entity Status under 37 CFR § 1.27(a) and is asserting Small Entity Status under 37 CFR § 1.27 (c).
- X Submitted herewith is a check in the amount of \$ 80.00. The Commissioner is hereby authorized to charge any deficiency or credit any excess to Deposit Account No. 14-0112.
- X Direct all correspondence to Customer Number 020529.

Respectfully submitted,

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Patent, Trademark and Copyright Causes  
Unfair Competition, Trade Secrets,  
Licensing and Litigation

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\*Practice limited to Matters and Proceedings  
before Federal Courts and Agencies; not  
Admitted in DC

\*\* Registered Patent Agent; not Admitted in DC

**COVER SHEET FOR FILING U.S. PROVISIONAL APPLICATION**  
**UNDER 37 CFR 1.53(c)**

Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

Re: New U.S. Provisional Patent Application  
For: **IMPROVEMENTS IN DIGITAL SPIRIT LEVELS**  
Inventor(s): David ARLINSKY  
Attorney Docket: 82591PRO

Sir:

This is a request for filing a PROVISIONAL APPLICATION FOR  
PATENT under 37 CFR 1.53(c).

Attached hereto is the application identified above, includ-  
ing:

7 Pages Application Consisting of:  
3 Pages of Textual Specification  
0 Pages of 0 claims  
0 Page of the Abstract  
4 Pages of Drawings

The present provisional application names the following  
inventor(s): ARLINSKY, David who resides in Atlit, Israel.

The Government filing fee\* is calculated as follows:  
Base Fee (Provisional Application) . . . . . \$ 160.00

**TOTAL FILING FEE\***  
(accounting for possible small entity status) . . . . . \$ 80.00

# IMPROVEMENTS IN DIGITAL SPIRIT LEVELS

The present invention relates to improvements in digital spirit levels.

## Invention I: Horizontal Display of Inclination Angle

Figures 1, 2 and 3 are schematic diagrams of a digital spirit level 1 including an inclination measurement device 2 for horizontally displaying the inclination angle of a surface on a dot matrix display 3 regardless of the inclination angle thereby facilitating its reading.

## Invention II: Closed Loop Inclination Measurement Module

Figure 4 is a schematic diagram of a digital spirit level 11 including a closed loop inclination measurement module 12 for determining the inclination angle of a surface relative to the horizontal. The inclination measurement module 12 includes a liquid containing vessel 13 containing a largely dielectric liquid 14 having a meniscus 15 located at a reference position when the digital spirit level 11 is placed on a horizontal surface, a meniscus position detector 16 for optically detecting the instantaneous position of the meniscus 15, an electric field generator 17 for generating an electrical field for inducing an electric charge in the liquid 14 for controlling the position of the meniscus 15, and inclination compensation circuitry 18 for controlling the electric field generator 17 for maintaining the meniscus 15 at its reference position and determining the inclination angle of a surface relative to the horizontal as a function of the strength of the electric field. The inclination measurement module 12 also preferably includes an illumination source 19 for illuminating the liquid containing vessel 13. The largely dielectric liquid 14 is comparable to liquids in conventional spirit levels insofar as it remains liquid over a temperature range including  $<0^{\circ}\text{C}$  for cold weather use of the digital spirit level 11, reacts quickly to changes in the inclination angle of a surface, and the like.

Figure 5 shows a first preferred embodiment of the inclination measurement module 12 in which the liquid containing vessel 13 is in the form of a bubble vial 21 having an air bubble 22 defining the meniscus 15, the

## IMPROVEMENTS IN DIGITAL SPIRIT LEVELS

meniscus position detector 16 includes a pair of photodetectors 23 deployed at opposite ends of the air bubble 22 in its reference position, and the electrical field generator 17 is in electrical connection with an earth node 24 largely co-extensive with the bubble vial 21 along its longitudinal axis, and a pair of positive nodes 26A and 26B deployed parallel to the earth node 24 at opposite ends of the bubble vial 21.

Figure 6 shows a second preferred embodiment of the inclination measurement module 12 in which the liquid containing vessel 13 is constituted by a toroid 27 having a pair of menisci 15A and 15B, the meniscus position detector 16 includes a photodetector 25 for detecting the position of the meniscus 15A relative to its reference position, and the electrical field generator 17 is in electrical connection with an earth node 27 deployed at the bottom of the toroid 26 and a pair of positive nodes 28A and 28B deployed approximate the reference positions of the menisci 15A and 15B.

### Invention III: Self-Calibrating Capacitive Inclinometer

Figure 7 is a schematic diagram of a digital spirit level 31 including a self-calibrating capacitive inclinometer 32 for displaying the inclination angle of a surface on a display 33. The inclinometer 32 is formed in a housing having a central partition dividing the housing into two compartments for implementing two variable capacitors 34 and 36, and includes a pair of registers 37 and 38 for storing temporary offsets therefor. The inclinometer 32 also includes horizontal reference circuitry 39 for precluding periodic calibration of the digital spirit level 31. The horizontal reference circuitry 39 includes a pair of reference electrodes 41 and 42 in a dielectric liquid 43, and a registry 44 for permanently storing a calibration offset for the reference electrodes 41 and 42.

Each compartment is formed with a variable capacitor of the parallel plate type with opposite plates formed on opposite major surfaces and also containing the dielectric liquid 43. The variable capacitor 34 has a pair of

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opposite plates 46 whose radial length  $L$  uniformly continuously decreases from a maximum radial length at horizontal  $0^\circ$  to a minimum radial length at  $360^\circ$  (see Figure 8) for sensing changes in the inclination angle of a surface over the full range of  $360^\circ$  without blind spots. The active area of the variable capacitor 34 uniformly continuously decreases over the range of horizontal  $0^\circ$  through to  $360^\circ$  thereby affording a uniformly continuously increasing capacitance  $C$  in accordance with the relationship  $C = \epsilon A/d$  where  $\epsilon$  is the coefficient of the dielectric liquid, and  $d$  is the separation between its plates. The variable capacitor 36 has a pair of plates similar to those of the capacitor 34 but inverted thereby affording a continuously decreasing capacitance over the range of horizontal  $0^\circ$  through to  $360^\circ$ . The provision of the two variable capacitors 34 and 36 doubles the capacitance change/ $^\circ$  of the inclinometer 32 compared to the capacitance change/ $^\circ$  of the capacitors 34 and 36 thereby improving its sensitivity.

The use of the digital spirit level 31 is as follows:

The digital spirit level 31 is placed on a horizontal surface and the horizontal reference circuitry 39 stores a calibration offset in the registry 44. During use of the digital spirit level 31, various factors may affect its calibration, for example, the height of the dielectric liquid 43 may vary due to ambient temperature, and the like. Conventional digital spirit levels require calibration involving a user placing them on a surface at two diametrically opposite orientations before use. In the case of the digital spirit level 31, each time the horizontal reference circuitry 39 senses a horizontal positioning of the digital spirit level 31, the inclinometer 32 updates the two registers 37 and 38 such that the inclinometer 32 displays an accurate inclination angle of a surface.



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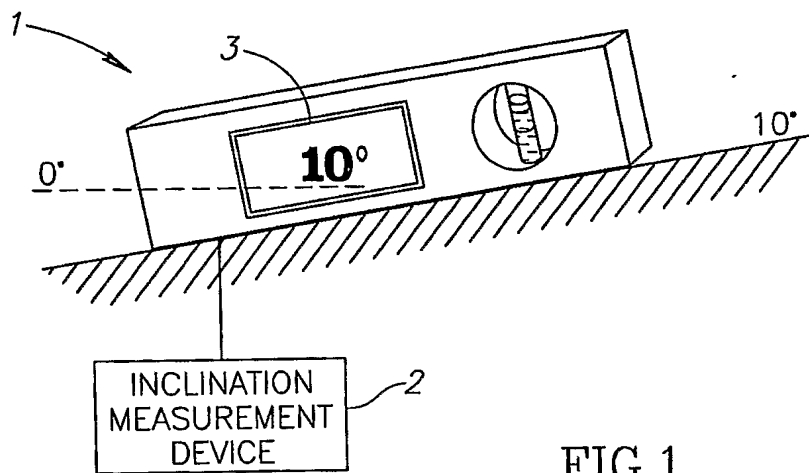


FIG.1

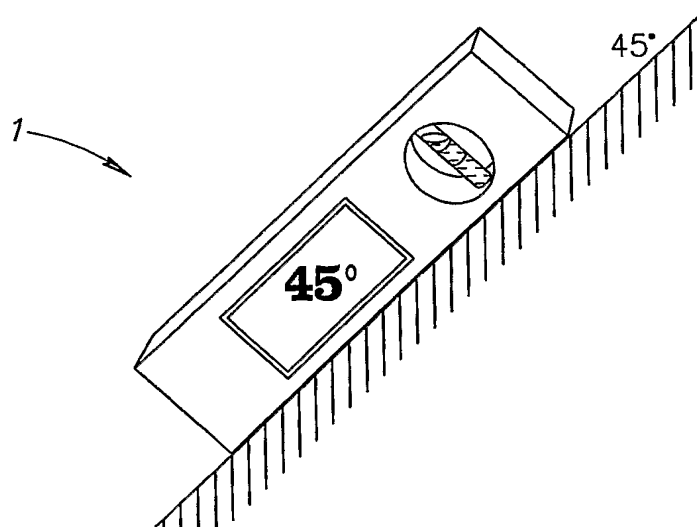


FIG.2

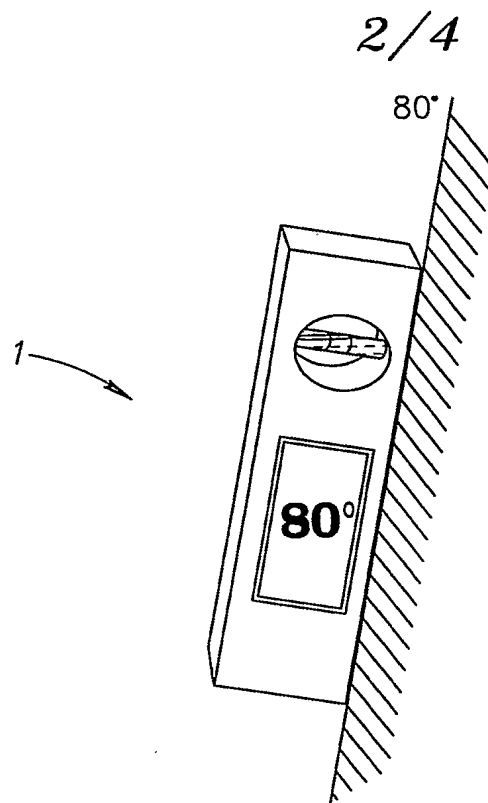


FIG. 3

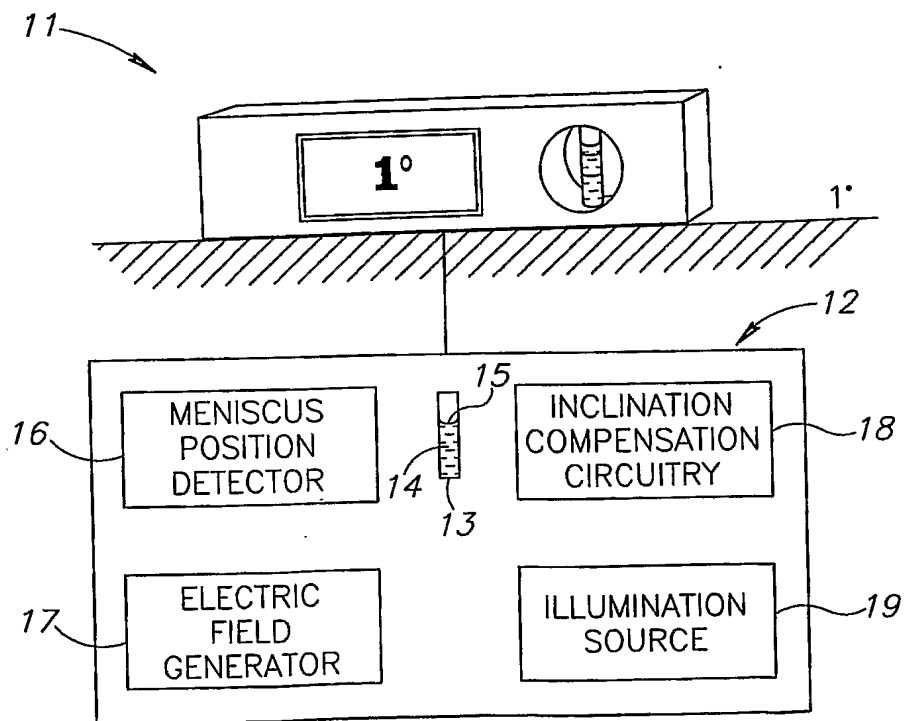


FIG. 4

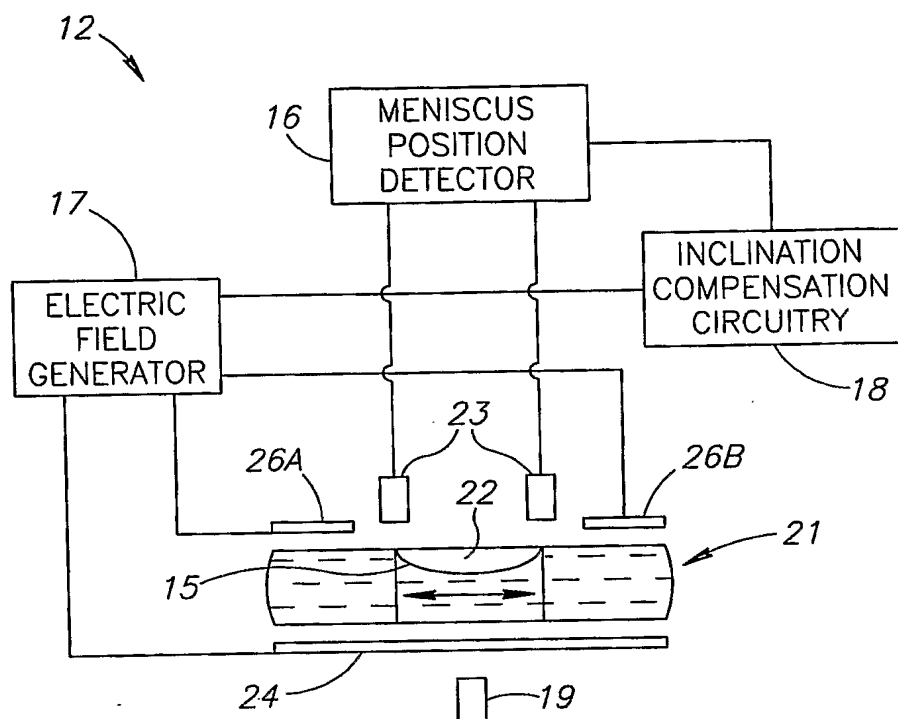


FIG. 5

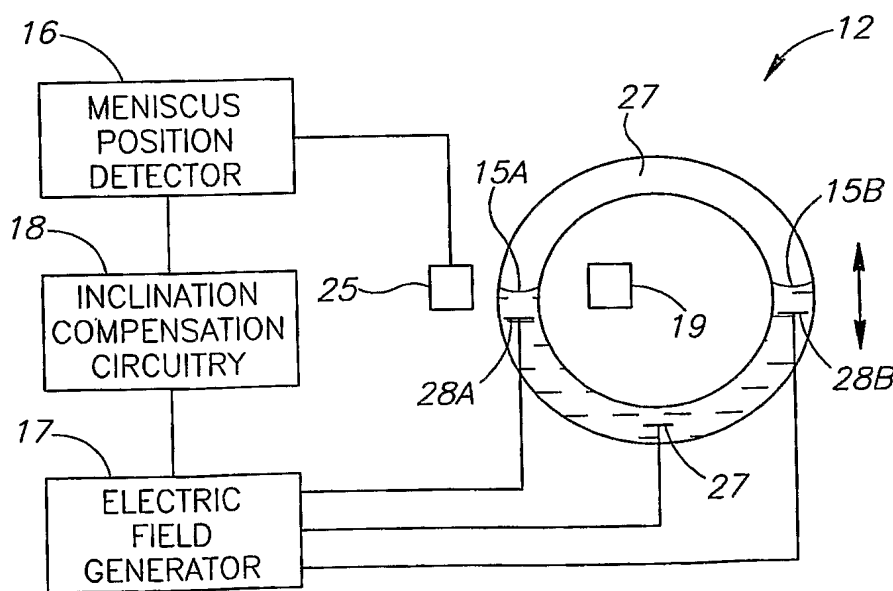


FIG. 6

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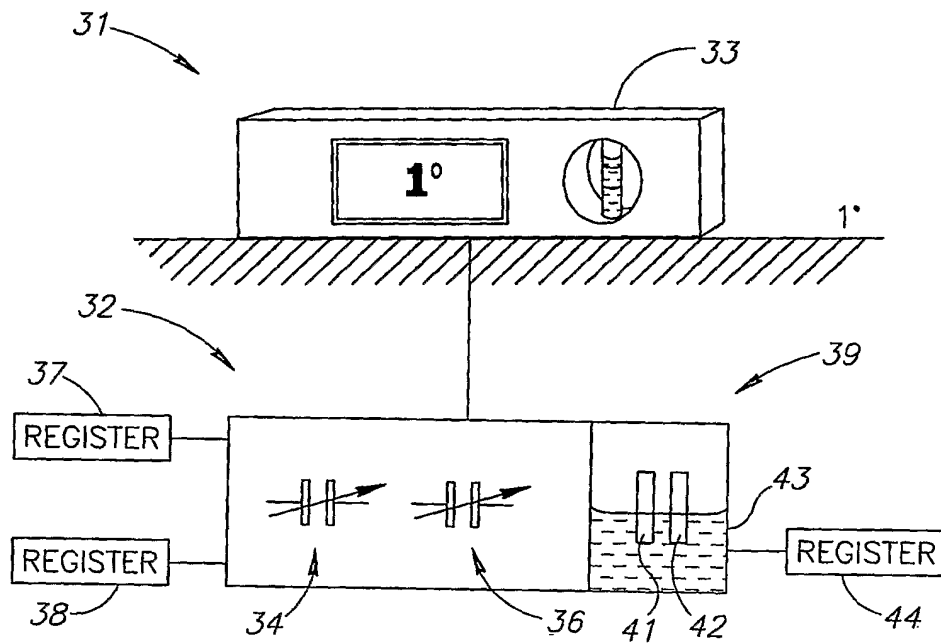


FIG. 7

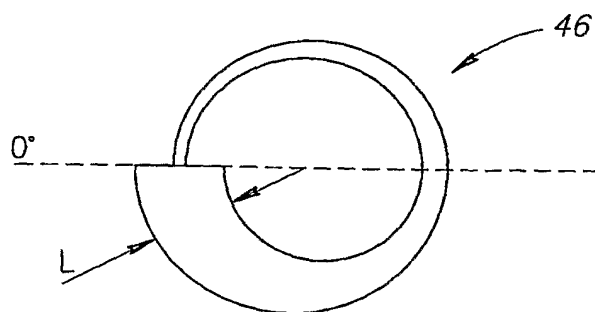


FIG. 8